9303 / 9505 Installation & Operation







PROFESSIONAL POWER AMPLIFIER

NOTICE - IMPORTANT SAFETY INFORMATION



WARNING: TO PREVENT FIRE OR SHOCK HAZARD, DO NOT EXPOSE THIS EQUIPMENT TO RAIN OR MOISTURE.





The lightning flash with arrowhead symbol within an equilateral triangle is intended to alert the user to the presence of uninsulated "dangerous voltage" within the product's enclosure, that may be of sufficient magnitude to constitute a risk of electric shock to persons.

The exclamation point within an equilateral triangle is intended to alert the user of the presence of important operating and maintenance (servicing) instructions in the literature accompanying the appliance.

1. READ INSTRUCTIONS

All the safety and operating instructions of your Hafler equipment should be read before power is applied to the equipment.

2. RETAIN OWNER'S MANUAL

These safety and operating instructions should be retained for future reference.

3. HEED WARNINGS

All warnings on the equipment and in the operating instructions are important and should be followed.

4. FOLLOW INSTRUCTIONS

All operating and use instructions are important and should be followed.

HEAT

The equipment should be kept away from areas of high temperature, i.e., heater vents, radiators, stoves/ovens, fireplaces, etc.

6. **VENTILATION**

The equipment should be used in an area suitable for proper ventilation. Care should be taken not to impede airflow in and around the cabinet. Do not mount on a carpeted shelf or in a sealed enclosure. Allow for proper clearance above the equipment.

WATER AND MOISTURE

The equipment should not be used in or around water, such as a bathtub, sink, or swimming area. Also, the equipment should not be used in areas prone to flooding, such as a basement.

8. POWER SOURCES

The equipment should be connected only to a power source of the same voltage and frequency as that listed on the rear panel above the power cord entry point.

9. POWER CORD PROTECTION

Power cords should be arranged so they do not interfere with the movement of objects in the room: people, fan blades, utility carts, etc. Also, care should be taken that the cord is not pinched or cut, and placed so it is not in danger of being pinched or cut, as in under a rug, around a tight corner, etc.

10. POWER CORD GROUNDING

The power supply cord is of a three wire grounded type, designed to reduce the risk of electric shock sustained from a live cabinet. It is assumed to be of suitable length for most uses of the equipment. The use of extension cords and power strips is discouraged unless they are of suitable rating to deliver the required total current for safe operation of all connected equip-

ment. Furthermore, extension cords or power strips must provide the same three wire grounded connection. It is important that the blades of the equipment's plug be able to fully insert into the mating receptacle. Never remove the round grounding pin on the plug in an attempt to mate to a two wire ungrounded receptacle: use a grounding adaptor with the grounding tab or wire suitably connected to earth ground.

11. NON-USE PERIODS

During periods of extended non-use, the power cord should be unplugged from the power source.

12. CLEANING

The equipment should be cleaned only as detailed in the operating instructions.

13. OBJECT AND LIQUID ENTRY

Care should be taken so that objects and/or liquids, such as cleaning fluids or beverages, are not spilled into the enclosure of the equipment.

14. DAMAGE REQUIRING SERVICE

Hafler equipment should be serviced by qualified service personnel when:

- A. The power supply cord or plug has been damaged, or
- B. Objects have fallen, or liquid has been spilled into the equipment, or
- C. The equipment has been exposed to rain, or
- D. The equipment does not appear to operate normally or exhibits a marked change in performance, or
- E. The equipment has been dropped, or the enclosure has been damaged.

15. **SERVICING**

The user should not attempt to service the equipment beyond that which is described in the operating instructions. All other service should be referred to qualified service personnel.

16. CARTS AND STANDS

The equipment should be used with carts or stands only of sufficient strength and stability for the use intended.

An equipment and cart combination should be moved with care. Quick stops and starts, excessive force, and uneven surfaces may cause the equipment and cart combination to topple.

PERFORMANCE SPECIFICATIONS

9303/9505

Full Power Bandwidth: 0.15Hz to 300kHz

Signal-to-Noise: >100dB "A" Weighted

Slew Rate: $150 \text{ V/}\mu\text{s}$

CMRR: 75dB at 1kHz

Gain: +29dB max.

9303

Power Rating: 150 wpc @8 Ω , 225 wpc @ 4Ω , 450 Watts mono @ 8Ω

Distortion: 0.07% THD 20-20Hz, Typically 0.005% THD 1kHz, at rated power into 8Ω

Damping Factor: 800 (to 1kHz); 80 (to 20kHz); 20 (to 100kHz) into 8Ω

Input Sensitivity Range: 1.22 Vrms for 150W into 8Ω , 1.06Vrms for 225W into 4Ω

Dimensions: 19"W x 12-1/2"D x 3-1/2"H (excluding feet)

Weight: 36 lbs. (16.4kg)

Power Consumption: Quiescent, 84 VA; at rated power, 612 VA (150W into 8 Ω , both channels driven)

9505

Power Rating: 250 wpc @8 Ω , 375 wpc @ 4Ω , 750 Watts mono @ 8Ω

Distortion: 0.1% THD 20-20Hz, Typically 0.005% THD 1kHz, at rated power into 8Ω

Damping Factor: 1000 (to 1kHz); 100 (to 20kHz); 20 (to 100kHz) into 8Ω

Input Sensitivity Range: 1.58 Vrms for 250W into 8Ω , 1.37Vrms for 375W into 4Ω

Dimensions: 19"W x 12-1/2"D x 5-1/4"H (excluding feet)

Weight: 50 lbs. (22.7kg)

Power Consumption: Quiescent, 132 VA; at rated power, 1020 VA (250W into 8Ω , both channels driven)

TABLE OF CONTENTS

SAFETY PRECAUTIONS	i
PERFORMANCE SPECIFICATIONS	i
INTRODUCTION	1
INSTALLATION	
Location	1
AC Line	1
Input	2
Balanced Input: 1/4" Tip Ring Sleeve	2
Balanced Input: XLR	2
Unbalanced Input	2
Unbalanced Source with Balanced Input	2
Output Connections	2
Monophonic Use	2
OPERATION	
Power Switch	3
Balanced/Unbalanced Input Switch	
Ground Switch	
Mono Switch	
Load Fault Protection	
Warm Up	
Cleaning and Maintenance	
Schematic Diagram	
PC Board Layout	
Parts List	
9303/9505 Functional Block Diagram	
TECHNICAL INFORMATION	
Theory and Operation of trans • nova	Ç
Circuit Implementation	
Calibration	
Common Mode Rejection	
Bias	
MADD ANTIV	

INTRODUCTION

The Hafler 9303 and 9505 are two channel professional power amplifiers. Passive cooling with large heatsinks is used for low mechanical noise. Our patented **trans•nova** circuit topology and MOSFET output stage ensures trouble free, long term operation and is backed by our seven year warranty.

This manual contains information on using the 9303 and 9505 amplifiers. It is organized into three main sections. "Installation" covers the location and connection of the amplifier in the system. Like many precision components careful attention to the initial setup can yield dividends in higher performance and trouble-free use. "Operation" covers the controls and features of the amplifiers and how to use them to get the best effect. The "Technical Information" section contains information on the circuit implementation and the schematic diagram and parts list. We strongly urge reading over the Installation and Operation portions of this manual before putting the amplifier into service.

The circuitry used in the 9303 and 9505 is the latest refinement of our **trans*nova** (TRANSconductance NOdal Voltage Amplifier, US Patent 4,467,288) circuit. The 9303 and 9505 utilize our proprietary DIABLO (patent application in progress) transconductance driver stage which combines the linearity of Class A operation with the current headroom of a Class B system. When used in combination with the robust output stage used with these models, DIABLO yields lower high frequency distortion without the sonic penalties associated with increasing the negative feedback.

The 9303 and 9505 have fully differential inputs for use in balanced line systems. The balanced input terminals work with either 1/4" TRS phone or XLR plugs. Gold-plated RCA phono jacks are available for use with unbalanced source components. The output terminals are gold-plated binding posts, spaced on 3/4" centers for use with dual banana plugs. For high power applications, the amplifier can run in bridged mono for double the output voltage. Using state-of-the-art surface mount assembly equipment in our manufacturing facility ensures consistency and reliability.

INSTALLATION I

LOCATION

The 9303 and 9505 can produce considerable heat in normal operation so the primary consideration when determining a location for the amplifiers is to allow for adequate ventilation. The large heatsinks provide unrestricted airflow, but care must be taken to keep the slots in the bottom panel and top cover clear, as well. If the amplifier is mounted in an equipment rack, make sure adjacent equipment does not impede cool air flow through the amplifier bottom and out the top. The attached feet provide sufficient clearance for the bottom when the amplifier is resting on a hard surface. Inadequate ventilation can shorten component life, especially when other equipment raises the ambient air temperature, so a circulating fan should be considered in tight quarters. The power transformer can generate a substantial magnetic field, so caution should be exercised in the placement of low level components such as a tape deck, mixer or mic preamp to avoid inducing noise in the low level circuitry.

AC LINE

The 9303 and 9505 operate from a 120 volt, 60Hz AC power line. Connection is made by an IEC Type 320, grounded line cord. For safety considerations only a properly grounded (earthed) receptacle should be used. If a grounded circuit is not available do not break off the ground pin; use the proper adapter plug for a two wire receptacle. Located inside the amplifier is the line fuse which interrupts the power to the amplifier. If this fuse blows replace it only with the same type and rating fuse. The correct replacement fuse value is included in the parts list in the "Technical Information" section of this manual. If the replacement fuse blows, this is an indication of a fault with the amplifier. Servicing should be performed only by a qualified technician.

INPUT

The 9303 and 9505 have input jacks for both balanced and unbalanced input signals. The unbalanced inputs use conventional RCA phono jacks. When using the RCA inputs, the rear panel BALANCED/UNBALANCED switch must be set to the UNBALANCED position. The balanced input jacks are dual function connectors which accept 1/4" TRS (Rip Ring Sleeve) phone or XLR plugs. Set the BALANCED/UNBALANCED switch to the BALANCED Position to use these jacks. The connector pin-out is printed on the rear panel of the amp.

Balanced Input: 1/4" Tip Ring Sleeve

The 1/4" balanced input jack is connected according to conventional usage with the Tip high (+), Ring return (-) and the Sleeve ground shield.

Balanced Input: XLR

The XLR balanced input jack is connected according to the IEC International Standard, with pin 2 high (+), pin 3 return (-) and pin 1 ground shield. When preparing to use the amplifier, check the output configuration of the source unit to maintain the proper signal polarity.

Unbalanced Input

Many popular mixers use unbalanced RCA phono jacks for the monitor outputs. For short cable runs RCA audio patch cable can be used without any system performance penalty. Check the mixer specs for the maximum cable length it will drive. Make sure the BALANCED/UNBALANCED switch is set for UNBALANCED operation.

Unbalanced Source with Balanced Input

Better noise rejection for long cable runs can be achieved by using a twisted pair balanced cable from the unbalanced source. At the source end of the cable, connect an RCA plug with the return (–) wire and shield connected to the ground shell of the plug. Wire the plug at the amplifier end of the cable the same as for the regular balanced input connection.

OUTPUT CONNECTIONS

The speaker output connectors are dual binding posts. These binding posts will directly accept 12 AWG wire or banana plugs and are spaced on 3/4" centers to accept dual banana plugs.

MONOPHONIC USE

For systems with high power requirements, the amplifiers can be configured for single channel bridged mono operation. To bridge the amplifier, set the rear panel STEREO/MONO switch to the Mono position; use only the left channel input, and connect the speaker to the red output binding posts. When the amplifier is bridged, the output is floating. Any speaker which requires a common ground from the amplifier output cannot be used in this application. Since a bridged amplifier shares the load between the two channels, the amplifier will effectively drive half of the load. Therefore, for bridged mono operation we recommend using an eight ohm load as the minimum impedance.

OPERATION

POWER SWITCH

The POWER switch is located on the front panel of the amplifier. An internal lamp indicates when it is turned on. Standard practice is to turn the amplifier on last and off first when switching components individually to prevent sending damaging transients, generated in the source components, to the speakers. It is possible to leave the power switch in the on position and switch the amplifier remotely through a power distribution block or preamp switched outlet. When doing so make sure the switch is rated for the current required by the amplifier.

BALANCED/UNBALANCED INPUT SWITCH

The BALANCED/UNBALANCED switch configures the input grounding when using the RCA phono input jacks. In the UNBALANCED position the balanced differential input return (–) port is grounded inside the amplifier. This prevents noise pickup or unstable amplifier operation caused by the open input. In the BALANCED position the differential amplifier inputs are connected to the hot (+) and (–) incoming signal connectors.

GROUND SWITCH

Ground loops are characterized by a hum or buzz in the system and are caused by a voltage potential difference between two points in a ground circuit. Ground loops are aggravated when multiple paths exist for a given circuit. Mounting components in a rack with metal rails may introduce ground loops between associated equipment, because the rails can establish an additional ground path. The CHASSIS/FLOAT switch allows you to select the amplifier grounding scheme for best system compatibility. With the switch in the CHASSIS position all signal grounds are referred to the chassis and power line ground. In the FLOAT position the signal ground is decoupled from the chassis. The position of the switch is determined by the overall noise in the system; choose the position which gives the lowest hum.

MONO SWITCH

Conventional two-channel stereo operation is obtained with the STEREO/MONO switch in the STEREO position. For high powered single channel use, set the switch to MONO and use the left channel input and the RED binding posts only for the output. For thermal considerations we do not recommend using less than an eight ohm load on the amplifier when running it in mono. When the switch is set in the mono position the left channel (+) and (-) inputs are connected to the right channel in reversed polarity, which inverts the right channel output.

LOAD FAULT PROTECTION

Because of the self-protecting properties and fault tolerance of the lateral MOSFETs used in the 9303 and 9505, elaborate voltage and current limiting protection schemes are not necessary. To prevent damage to the amplifier from a fault in the loudspeaker load, the power supply B+ and B- rails are fused. Check these fuses if the sound is garbled or there is no output. The fuses should not blow under normal use and a blown fuse is usually an indication of a fault. The fault could be a bad connection, a problem with the speaker or a short in the speaker line. **Disconnect power to the amplifier before removing the cover**.

WARM UP

In order to achieve the best sonic performance from the amplifier, we recommend letting it warm up for 1 hour before beginning any critical listening. The amplifier will not deliver its full potential sound quality before this time has passed.

CLEANING AND MAINTENANCE

There is no requirement for regular maintenance on the electronic components of the amplifier. If the case becomes soiled it can be cleaned using a soft cloth and a mild detergent, such as spray window or glass cleaner. If the amplifier is located in a particularly dusty environment cleaning the inside with compressed air or vacuuming every 18 to 24 months is sufficient.

SCHEMATIC DIAGRAMI

NOTES: Unless specified otherwise

- 1. All resistors in ohms
- 2. All capacitors in microfarads
- Component Designators:
 1-99: Left Channel
 101-199: Right Channel
 201-299: Common Parts
 301-399: Chassis/Power Supply
- 4. Left Channel Only Shown
- 5. Stereo/Mono Switch Shown in Stereo
- 6. Balanced/Unbalanced Switch Shown in Balanced Position
- 7. Chassis/Float Ground Switch Shown in Float Position

Parts List

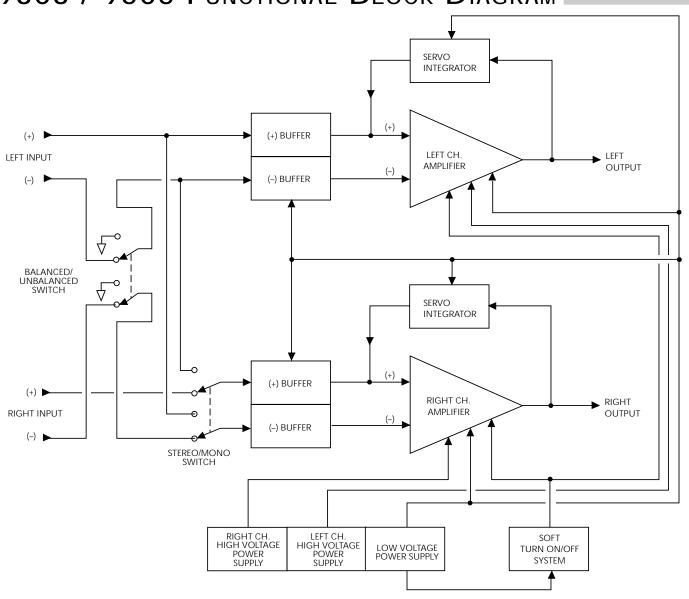
ALL RESIGNES IN CHMNS R1, R101	DESIGNATOR		PART #	DESIGNATOR	VALUE	PART #
R1, R101	ALL RESISTORS	III OHIVIS		R213	220. 1/4W. 5%	RM/4-221C
R2, R102	R1. R101	47.5k. 1/4W. 1%	RM/4-4752C			
R3, R103						
R4. R104						
RS, R105 2 22M, 14W, 5% RM4-225C P2, P202 220 Imm Pot RV1-201 RV, R107 22K, 14W, 5% RM4-23C D2, D102 BAV99L SS, 2605M RV, R107 22K, 14W, 5% RM4-101C D3, D103 BAV99L SS, 2605M RV, R107 100, 14W, 5% RM4-101C D3, D103 BAV99L SS, 2605M RV, R107 100, 14W, 5% RM4-101C D3, D103 BAV99L SS, 2605M RV, R107 110, 14W, 5% RM4-101C D4, D101 BAV99L SS, 2605M RV, R107 111 R111 2 332, 14W, 1% RM4-021C D5, D105 BAV99L SS, 2605M RV, R12, R112 332, 14W, 1% RM4-021C D5, D105 BAV99L SS, 2605M RV, R12, R112 332, 14W, 1% RM4-021C D201 115/24B 15V SS, 212 RV4, R114 221, 14W, 1% RM4-021C D201 115/24B 15V SS, 212 RV4, R114 221, 14W, 1% RM4-021C D202 BAV99L SS, 2605M RV5, R14, R114 221, 14W, 1% RM4-021C D203 115/24B 15V SS, 212 RV4, R114 221, 14W, 1% RM4-021C D203 115/24B 15V SS, 212 RV4, R114 11 RV4, 1% RM4-021C D203 115/24B 15V SS, 212 RV6, R116 221, 14W, 1% RM4-021C D203 115/24B 15V SS, 212 RV6, R116 221, 14W, 1% RM4-021C D203 115/24B 15V SS, 212 RV6, R116 221, 14W, 1% RM4-021C D203 115/24B 15V SS, 212 RV6, R116 221, 14W, 1% RM4-021C D203 115/24B 15V SS, 212 RV6, R116 221, 14W, 1% RM4-021C D203 115/24B 15V SS, 212 RV6, R116 221, 14W, 1% RM4-021C D203 115/24B 15V SS, 212 RV6, R116 221, 14W, 1% RM4-021C D203 115/24B 15V SS, 212 RV6, R116 221, 14W, 1% RM4-021C D203 115/24B 15V SS, 212 RV6, R116 221, 14W, 1% RM4-021C D203 115/24B 15V SS, 212 RV6, R117 RV7, R117 R						
R. R. R. D. D. D. D. D.				P2, P202	200 Trim Pot	RVH-201
R.P. RIOT 22k, 144W, 5% RMM4-23C D2_D102 BAAY90L SS_205M R9_RIO9 100, 144W, 5% RMM4-101C D4_D104 BAAY90L SS_205M R9_RIO9 100, 144W, 5% RMM4-101C D4_D104 BAAY90L SS_205M R9_RIO9 100, 144W, 5% RMM4-101C D4_D104 BAAY90L SS_205M R11_RIT11 100, 144W, 5% RMM4-101C D6_D106 BAAY90L SS_205M R11_RIT11 100, 144W, 5% RMM4-101C D6_D106 BAAY90L SS_205M R11_RIT11 20, 114W, 5% RMM4-201C D2_D107				D1 D101	RAV/QQI	M20AC 22
Fig. 100						
R9, R109 100, 14WJ, 5% RMM-1-D1C D4, D104 BAV99L \$\$2,205M R10, R110 302, 14WJ, 1% RMM-1-D1C D6, D106 BAV99L \$\$2,205M R11, R111 302, 14WJ, 1% RMM-1-D1C D6, D106 BAV99L \$\$2,205M R12, R112 302, 14WJ, 1% RMM-1-D1C D6, D106 BAV99L \$\$2,205M R12, R113 302, 14WJ, 1% RMM-1-D1C D00 BAV99L \$\$2,205M R14, R113 22,1, 14WJ, 1% RMM-1-D2C D201 118,248 B15V \$\$2,712 R14, R114 22,1, 14WJ, 1% RMM-102C D202 BAV194 B15V \$\$2,712 R16, R116 22,1, 14WJ, 1% RMM-102C D204 118,248 B15V \$\$2,712 R16, R118 28,14WJ, 1% RMM-102C D204 118,248 B15V \$\$2,712 R17, R117 K1,14WJ, 5% RMM-102C D204 118,248 B15V \$\$2,712 R18, R118 28,14WJ, 1% RMM-2802 O2 U,1 U10 NPD58566 \$\$665 R20, R128 R3,23,24,24WJ, 1%		100, 1/4W, 5%	RM/4-101C			
\$10, \$110 342, 1444, 156 \$100, 1444, 5% \$80,44-3320C \$0,5105 \$84,990L \$5.2605M \$12, \$111 \$22, 1, 1444, 156 \$80,44-0221C \$0,701 \$100, 1444, 5% \$80,44-0221C \$0,701 \$100, 1444, 5% \$80,44-0221C \$0,701 \$100, 1444, 5% \$10,510 \$10,51	R9, R109	100, 1/4W, 5%	RM/4-101C			
R11, R111	R10, R110	332, 1/4W, 1%	RM/4-3320C			
R12, R112 332, 14W, 1% RM4-3320C D7, D107 BAV991 SS-260SM R13, R113 221, 14W, 1% RM4-0221C D202 BAV991 SS-260SM R14, R114 221, 14W, 1% RM4-0221C D203 BAV991 SS-260SM R16, R116 221, 14W, 1% RM4-0221C D203 11824B815V SS-212 R16, R116 221, 14W, 1% RM4-0221C D204 11824B815V SS-212 R18, R118 281, 14W, 1% RM4-102C U.1 U101 MPD55566 SS-8665 R18, R118 281, 14W, 1% RM4-2802.03 U.1. U101 MPD55566 SS-8665 R18, R118 281, 14W, 1% RM4-100C U201 LD770D SS-1838M R20, R120 300, 14W, 1% RM4-100C U202 LM337 SS-240-056 R22, R123 332, 14W, 1% RM4-330C C1. C101 330pf, 500V CM-331-024 R22, R123 352, 14W, 1% RM4-330C C3. C103 O474F, 50V CW-331-024 R22, R126 56, 16W, 5%	R11, R111	100, 1/4W, 5%	RM/4-101C			
R13, R113 22.1, 1/4W, 1% RM4-0221C D201 1M52488 15V SS.212 R14, R114 22.1, 1/4W, 1% RM4-0221C D202 BA/99L SS.260SM R15, R115 22.1, 1/4W, 1% RM4-0221C D203 1M52488 15V SS.212 R16, R116 22.1, 1/4W, 1% RM4-0221C D204 1M52488 15V SS.212 R17, R117 1k, 1/4W, 1% RM4-102C RM4-101C D203 U1. U101 NPD55566 SS-0865 R18, R118 228, 1/4W, 1% RM4-101C U201 1U7.2CD SS-1458M R19, R119 909, 1/4W, 1% RM4-4300C U202 LM337 SS-240-056 R21, R121 332, 1/4W, 1% RM4-4350C U203 LM377 SS-240-056 R23, R123 332, 1/4W, 1% RM4-580C C1, C101 330pF, 500V CM-331-024 R28, R126 56, 1/4W, 5% RM4-580C C3, C103 0.4/1/F, 50V CM-331-024 R28, R126 56, 1/4W, 5% RM4-580C C3, C103 0.4/1/F, 50V CV-4714	R12, R112	332, 1/4W, 1%	RM/4-3320C			
R14, R114 22.1, 1/4W. 1% RM4-0221C D202 BAV99, S.S.20SM STEP, R115, R115 22.1, 1/4W. 1% RM4-0221C D203 11824B15V S.S.212 R16, R116 22.1, 1/4W. 1% RM4-0221C D204 11824B15V S.S.212 R16, R116 22.1, 1/4W. 1% RM4-0221C D204 11824B15V S.S.212 R16, R116 22.1, 1/4W. 1% RM4-2802.03 UJ. UJI01 MPD55564 S.S.0865 R18, R18 28, 1/4W, 1% RM4-2802.03 UJ. UJI01 MPD55564 S.S.0865 R18, R118 28, 1/4W, 1% RM4-2802.03 UJ. UJI01 MPD55564 S.S.0865 R20, R120 130, 1/4W. 5% RM4-101C UJ201 LM337 S.S.240-956 R22, R121 332, 1/4W, 1% RM4-330C UJ203 LM337 S.S.240-956 R22, R122 432, 1/4W, 1% RM4-330C UJ203 LM337 S.S.240-956 R22, R122 433, 1/4W, 1% RM4-330C UJ203 LM317 S.S.240-956 R22, R124 532, 1/4W, 5% RM4-330C C.C., C.1.C.101 330pf, S00V CM-331-024 R22, R124 532, 1/4W, 5% RM4-330C C.C., C.1.C.101 330pf, S00V CM-331-024 R22, R125 56, 1/4W, 5% RM4-330C C.C., C.1.C.101 330pf, S00V CM-331-024 R22, R125 10.1, 1/4W, 5% RM4-230C C.C., C.1.C.101 330pf, S00V CM-331-024 R22, R125 10.1, 1/4W, 5% RM4-230C C.C., C.1.C.101 300pf, S00V CM-331-024 R22, R126 10.1, 1/4W, 5% RM4-101C C.C., C.1.C.101 40, 1/4F, 50V CVV-104-024 R22, R127 10.1, 1/4W, 5% RM4-101C C.C., C.1.C.101 50, 1/4F, 50V CVV-104-024 R22, R129 100, 1/4W, 5% RM4-101C C.C., C.1.C.101 50, 1/4F, 50V CVV-104-024 R23, R131 100, 1/4W, 5% RM4-101C C.C., C.1.C.101 50, 1/4F, 50V CVV-104-024 R23, R133 100, 1/4W, 5% RM4-101C C.C., C.1.C.101 71, 1/4F, 50V CVV-104-024 R23, R133 100, 1/4W, 5% RM4-101C C.C., C.1.C.101 71, 1/4F, 50V CVV-104-024 R33, R133 100, 1/4W, 5% RM4-101C C.C., C.1.C.101 10, 1/4F, 50V CVV-104-024 R33, R133 100, 1/4W, 5% RM4-101C C.C., C.1.C.101 10, 1/4F, 50V CVV-104-024 R33, R133 100, 1/4W, 5% RM4-101C C.C., C.1.C.101 10, 1/4F, 50V CVV-104-024 R33, R133 100, 1/4W, 5% RM4-101C C.C., C.1.C.101 10, 1/4F, 50V CVV-104-024 R33, R133 100, 1/4W, 5% RM4-101C C.C., C.1.C.101 10, 1/4F, 50V CVV-104-024 R33, R133 100, 1/4W, 5% RM4-101C C.C., C.1.C.101 10, 1/4F, 50V CVV-104-024 R33, R134 11, 1/4W, 5% RM4-101C C.C., C.1.C.101 10, 1/4F, 50V CVV-104-024 R34, R134 11, 1/4W, 5% RM4-101C C.C., C.1.C.101 10, 1/	R13, R113	22.1, 1/4W, 1%	RM/4-0221C			
R15, R115	R14, R114	22.1, 1/4W, 1%	RM/4-0221C			
R16, R116						
R17, R117				D204	1N5245B 15V	
R19, R119 909 (14W, 196 RNM4-9090C U.9, U109 NPDS5566 SS-0865 R20, R120 100, 14W, 556 RM4-101C U.201 LT.072CD SS-143SM R21, R121 332, 14W, 196 RNM4-3320C U.202 LM337 SS-240-056 R23, R123 332, 14W, 196 RNM4-3320C U.203 LM337 SS-240-056 R23, R123 332, 14W, 196 RNM4-3320C C.7, C101 330pF, 500V CM-331-024 R25, R125 56, 14W, 556 RM44-560C C.2, C102 330pF, 500V CM-331-024 R25, R125 56, 14W, 556 RM44-560C C.2, C103 0.47pF, 50V CYV-474 R27, R127 2k, 14W, 596 RM44-200C C.4, C104 0.1pF, 50V CYV-104-024 R27, R127 2k, 14W, 596 RM44-200C C.5, C105 100pF, 50V CYV-104-024 R27, R127 100, 14W, 556 RM44-101C C.6, C106 0.1pF, 50V CYV-104-024 R27, R131 100, 14W, 556 RM44-101C C.6, C106 0.1pF, 50V CYV-104-024 R33, R131 100, 14W, 556 RM44-101C C.6, C108 0.1pF, 50V CYV-104-024 R33, R133 2k, 14W, 556 RM44-101C C.6, C108 0.1pF, 50V CYV-104-024 R33, R133 2k, 14W, 556 RM44-101C C.6, C108 0.1pF, 50V CYV-104-024 R33, R133 100, 14W, 556 RM44-101C C.6, C108 0.1pF, 50V CYV-104-024 R33, R133 100, 14W, 556 RM44-101C C.7, C109 0.1pF, 50V CYV-104-024 R33, R133 100, 14W, 556 RM44-101C C.7, C109 0.1pF, 50V CYV-104-024 R33, R133 100, 14W, 556 RM44-100C C.11, C111 100pF, 50V CYV-104-024 R33, R133 100, 14W, 556 RM44-100C C.12, C112 100pF, 50V CYV-104-024 R33, R133 100, 14W, 556 RM44-100C C.12, C112 100pF, 50V CYV-104-024 R33, R139 100, 14W, 556 RM44-100C C.12, C112 100pF, 50V CYV-104-024 R33, R139 100, 14W, 556 RM44-100C C.12, C112 100pF, 50V CYV-104-024 R33, R139 100, 14W, 556 RM44-100C C.12, C119 20, 000pF, 10V CYV-104-024 R33, R139 100, 14W, 556 RM44-100C C.14, C119 20, 000pF, 10V CYV-104-024 R33, R139 100, 14W, 556 RM44-100C C.14, C119 20, 000pF, 10V CYV-104-024 R33, R139 100, 14W, 556 RM44-100C C.14, C119 20, 000pF, 10V CYV-104-024 R33, R139 100, 14W, 556 RM44-100C C.14, C119 20, 000pF, 10V CYV-104-024 R33, R139 100, 14W, 556 RM44-100C C.14, C119 20, 000pF, 10V CYV-104-024 R33, R139 100, 14W, 556 RM44-100C C.14, C119 20, 000pF, 10V CYV-104-024 R33, R139 100, 14W, 556 RM44-100C C.14, C119 20, 000pF, 10V CYV-104-024 R33, R139 100, 14W, 556 RM44-100					115505577	
R20, R120						
R22, R122 332, 1/4W, 1% RM4-323CC U202 LM337 SS-240-056 R23, R123 332, 1/4W, 1% RM4-375DC U203 LM317 SS-240-056 R23, R123 332, 1/4W, 1% RM4-3/2DC C, C1, C101 330pf, 500V CM-331-024 R25, R125 56, 1/4W, 5% RM4-3/2DC C, C2, C102 330pf, 500V CM-331-024 R25, R125 56, 1/4W, 5% RM4-560C C, C3, C103 0.47pf, 50V CV-474 R26, R126 3.32k, 1/4W, 5% RM4-560C C, C3, C103 0.47pf, 50V CV-474 R26, R126 3.32k, 1/4W, 5% RM4-103C C, C3, C103 0.47pf, 50V CV-104-024 R28, R128 10k, 1/4W, 5% RM4-103C C, C5, C105 100pf, 50V CR, 1070-024 R28, R128 10k, 1/4W, 5% RM4-103C C, C6, C106 0.1pf, 50V CYV-104-024 R28, R128 10k, 1/4W, 5% RM4-101C C, C7, C107 100pf, 50V CR, 1070-024 R33, R33 100, 1/4W, 5% RM4-101C C, C9, C109 0.1pf, 50V CYV-104-024 R32, R132 100, 1/4W, 5% RM4-101C C, C9, C109 0.1pf, 50V CYV-104-024 R32, R132 100, 1/4W, 5% RM4-101C C, C10, C110 7pf, 500V CW-104-024 R33, R134 1k, 1/4W, 5% RM4-102C C, C12, C112 10pf, 50V CW-104-024 R33, R134 1k, 1/4W, 5% RM4-102C C, C12, C112 10pf, 500V CM-070-024 R33, R134 1k, 1/4W, 5% RM4-102C C, C12, C112 10pf, 500V CM-070-024 R33, R136 1k, 1/4W, 5% RM4-102C C, C13, C113 0.0pf, 500V CM-070-024 R33, R136 1k, 1/4W, 5% RM4-102C C, C13, C113 0.0pf, 500V CM-070-024 R33, R138 1k, 1/4W, 5% RM4-102C C, C13, C113 0.0pf, 500V CM-070-024 R33, R138 1k, 1/4W, 5% RM4-102C C, C14, C114 22pf, 500V CM-070-024 R38, R138 1k, 1/4W, 5% RM4-102C C, C15, C115 680pf, 500V CM-070-024 R38, R138 1k, 1/4W, 5% RM4-102C C, C15, C115 680pf, 500V CM-070-024 R38, R138 1k, 1/4W, 5% RM4-101C C, C16, C116 47pf, 500V CM-070-024 R38, R138 1k, 1/4W, 5% RM4-101C C, C16, C116 47pf, 500V CM-070-024 R38, R138 1k, 1/4W, 5% RM4-101C C, C16, C116 47pf, 500V CM-070-024 R38, R138 1k, 1/4W, 5% RM4-101C C, C16, C116 47pf, 500V CM-070-074 R48, R42 100, 1/4W, 5% RM4-101C C, C16, C116 47pf, 500V CM-070-074 R48, R42 100, 1/4W, 5% RM4-101C C, C16, C116 47pf, 500V CM-070-074 R48, R42 100, 1/4W, 5% RM4-101C C, C16, C116 47pf, 500V CM-070-074 R48, R43 1k, 1/4W, 5% RM4-101C C, C16, C116 47pf, 500V CM-070-074 R48, R44 100, 1/4W, 5% RM4-075C C, C20 1000pf, 5						
R22, R122 475, 1/4W, 1% RNM-4750C U203 LM317 SS 240-056 R23, R123 332, 1/4W, 1% RNM-3320C C1, C101 330pF, 500V CM-331-024 R24, R124 56, 1/4W, 5% RNM-560C C2, C102 330pF, 500V CM-331-024 R26, R126 3.32k, 1/4W, 1% RNM-560C C3, C103 0.47µF, 50V CYV-104-024 R26, R126 3.32k, 1/4W, 1% RNM-320C C4, C104 0.1µF, 50V CYV-104-024 R28, R128 10k, 1/4W, 5% RNM-103C C5, C105 100µF, 50V CYV-104-024 R29, R129 10k, 1/4W, 5% RNM-103C C6, C106 0.1µF, 50V CYV-104-024 R31, R131 10k, 1/4W, 5% RNM-101C C7, C107 C100pF, 50V CYV-104-024 R32, R132 10k, 1/4W, 5% RNM-101C C10, C110 7pF, 50V CW-104-024 R31, R131 10k, 1/4W, 5% RNM-101C C10, C110 7pF, 50V CW-104-024 R33, R133 1k, 1/4W, 5% RNM-102C C11, C111 100pF, 50V CW-104-024 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td></t<>						
R23, R123						
R24, R124 56, 1/4W, 5% RM4-560C C2, C102 330pf, 500V CM-331-024 R26, R125 6, 1/4W, 5% RM4-320C C3, C103 0.47µf, 50V CYV-474 C274 R26, R126 3.32k, 1/4W, 1/8 RM4-3321C C3, C103 0.47µf, 50V CYV-474 C274 R26, R128 10k, 1/4W, 5% RM4-103C C5, C105 100µf, 50V CR-1070-024 R28, R128 10k, 1/4W, 5% RM4-103C C5, C106 0.1µf, 50V CR-1070-024 R30, R130 10k, 1/4W, 5% RM4-101C C7, C107 100µf, 50V CR-1070-024 R31, R131 100, 1/4W, 5% RM4-101C C9, C109 0.1µf, 50V CYV-104-024 R31, R131 100, 1/4W, 5% RM4-101C C10, C110 7pf, 500V CYV-104-024 R33, R133 2k, 1/4W, 5% RM4-101C C10, C110 7pf, 500V CW-104-024 R33, R133 2k, 1/4W, 5% RM4-102C C11, C111 100pf, 500V CM-101-024 R33, R133 1k, 1/4W, 5% RM4-102C C12, C112 110pf, 500V CM-101-024 R35, R135 1k, 1/4W, 5% RM4-102C C12, C112 110pf, 500V CM-101-024 R35, R135 1k, 1/4W, 5% RM4-102C C12, C112 110pf, 500V CM-101-024 R35, R135 1k, 1/4W, 5% RM4-102C C13, C113 0.047µf, 50V CYV-134, C24 R37, R137 100, 1/4W, 5% RM4-101C C16, C116, C116 C176, C116 C176 C176, C176 C176, C176 C176, C176 C176 C176, C176 C176 C176, C176 C176 C176 C176 C176 C176 C176 C176				0203	LIVI317	55-240-056
R29, R124				C1, C101	330pF, 500V	CM-331-024
R26, R126 30, IA4W, 3% RIMA-302C C3, C103 0.47µF, 50V CYV-414 R27, R127 2k, IA4W, 5% RIMA-30321C C4, C104 0.1µF, 50V CFV-104-024 R27, R127 2k, IA4W, 5% RIMA-202C C5, C105 100µF, 50V CFV-104-024 R29, R129 100, IA4W, 5% RIMA-101C C6, C106 0.1µF, 50V CFV-104-024 R29, R129 100, IA4W, 5% RIMA-101C C7, C107 100µF, 50V CFV-104-024 R29, R139 100, IA4W, 5% RIMA-101C C9, C109 0.1µF, 50V CYV-104-024 R31, R131 100, IA4W, 5% RIMA-101C C9, C109 0.1µF, 50V CYV-104-024 R31, R131 100, IA4W, 5% RIMA-101C C9, C109 0.1µF, 50V CYV-104-024 R33, R133 2k, IA4W, 5% RIMA-101C C9, C109 0.1µF, 50V CYV-104-024 R33, R133 1k, IA4W, 5% RIMA-102C C11, C110 100µF, 500V CM-101-024 R33, R133 1k, IA4W, 5% RIMA-102C C12, C112 100µF, 500V CM-101-024 R35, R135 1k, IA4W, 5% RIMA-102C C12, C112 100µF, 500V CM-101-024 R35, R135 1k, IA4W, 5% RIMA-102C C13, C114 100µF, 500V CM-101-024 R37, R137 100, IA4W, 5% RIMA-102C C13, C113 100µF, 500V CM-101-024 R37, R137 100, IA4W, 5% RIMA-102C C14, C114 22µF, 500V CM-101-024 R37, R137 100, IA4W, 5% RIMA-102C C15, C115 60µF, 500V CM-202-024 R37, R137 100, IA4W, 5% RIMA-102C C15, C115 60µF, 500V CM-202-024 R39, R139 100, IA4W, 5% RIMA-101C C16, C116 47pF, 500V CM-401-024 R39, R139 100, IA4W, 5% RIMA-101C C16, C116 47pF, 500V CM-401-024 R39, R139 100, IA4W, 5% RIMA-101C C17, C117 47pF, 500V CM-401-024 R39, R139 100, IA4W, 5% RIMA-101C C19, C116 47pF, 500V CM-401-024 R39, R139 100, IA4W, 5% RIMA-101C C19, C116 47pF, 500V CM-401-024 R39, R139 100, IA4W, 5% RIMA-101C C19, C116 47pF, 500V CM-401-024 R39, R139 100, IA4W, 5% RIMA-101C C19, C116 47pF, 500V CP-475MC C40, R14, R141 100, IA4W, 5% RIMA-101C C20, C120 20, C00µF, 100V CP-475MC C40, R14, R141 100, IA4W, 5% RIMA-101C C20, C120 20, C120, E100PF, 50V C74-104-024 R39, R139 100, IA4W, 5% RIMA-101C C20 10,					•	
R22, R126 3.3.2K, 14W, 15% MM4-3321C C4, C104 0.1μF, 50V CVV-104-024 R28, R128 10k, 14W, 5% RM4-103C C5, C105 0.0μF, 50V CFR-107C-024 R30, R130 1k, 14W, 5% RM4-101C C7, C107 100μF, 50V CFR-107C-024 R30, R130 1k, 14W, 5% RM4-101C C8, C108 0.1μF, 50V CVV-104-024 R32, R131 100, 14W, 5% RM4-101C C9, C109 0.1μF, 50V CVV-104-024 R32, R132 100, 14W, 5% RM4-101C C9, C109 0.1μF, 50V CVV-104-024 R32, R132 100, 14W, 5% RM4-101C C9, C109 0.1μF, 50V CVV-104-024 R32, R133 1k, 14W, 5% RM4-102C C10, C110 T00pF, 500V CM-070-024 R34, R134 1k, 14W, 5% RM4-102C C12, C112 100pF, 500V CM-101-024 R35, R135 1k, 14W, 5% RM4-102C C13, C113 0.047μF, 50V CVV-473-024 R37, R137 100, 14W, 5% RM4-102C C14, C114 22pF, 500V CM-200-024 R37, R137 100, 14W, 5% RM4-101C C15, C115 680pF, 500V CM-810-024 R39, R139 100, 14W, 5% RM4-101C C15, C115 680pF, 500V CM-810-024 R39, R139 100, 14W, 5% RM4-101C C15, C115 680pF, 500V CM-470-024 R39, R139 100, 14W, 5% RM4-101C C17, C117 47,μF, 160V CPP-475MC R41, R141 100, 14W, 5% RM4-101C C19, C119 2000µF, 100V CFR-209E R43, R143 1k, 14W, 5% RM4-101C C19, C119 C100µF, 100V CFR-209E R43, R143 1k, 14W, 5% RM4-101C C19, C119 C100µF, 100V CFR-209E R43, R143 1k, 14W, 5% RM4-101C C19, C119 C100µF, 100V CFR-209E R43, R143 1k, 14W, 5% RM4-101C C20 C10, C10µF, 100V CFR-209E R43, R143 1k, 14W, 5% RM4-101C C20 C10, C10µF, 100V CFR-209E R44, R144 47, 51, 14W, 15% RM4-101C C20 C10, C10µF, 100V CFR-209E R45, R145 1k, 14W, 5% RM4-101C C20 C10µF, 50V C7V-104-024 C7V-					•	
R22, R122				•	•	CYV-104-024
R29, R129 100, 1/4W, 5% RM/4-101C C7, C107 C104F, 50V CFR-107C-024 R30, R130 1k, 1/4W, 5% RM/4-101C C8, C108 C1µF, 50V C7V-104-024 R32, R131 100, 1/4W, 5% RM/4-101C C9, C109 C1µF, 50V C7V-104-024 R32, R132 100, 1/4W, 5% RM/4-101C C9, C109 C1µF, 50V C7V-104-024 R32, R132 100, 1/4W, 5% RM/4-101C C9, C109 C1µF, 50V C7V-104-024 R32, R132 100, 1/4W, 5% RM/4-101C C10, C110 C10, C110 C100PF, 500V CM-101-024 R34, R134 1k, 1/4W, 5% RM/4-102C C11, C111 100pF, 500V CM-101-024 R35, R135 1k, 1/4W, 5% RM/4-102C C13, C113 C107F, 500V CM-101-024 R35, R135 1k, 1/4W, 5% RM/4-102C C13, C113 C147F, 50V C7V-473-024 R37, R137 100, 1/4W, 5% RM/4-101C C14, C114 C14, C114 C14, C14 C14, C14, C14, C14, C14, C14, C14, C14,					•	
R30, R130						CYV-104-024
R30, R130 IR, I/AWI, 5% RM/A-101C CB, C108 0.1 JIF, 50V CYV-104-024 R32, R132 100, 1/4W, 5% RM/A-101C C9, C109 0.1 JIF, 50V CYV-104-024 R32, R132 100, 1/4W, 5% RM/A-202C C10, C110 7pF, 500V CM-070-024 R34, R134 1R, 1/4W, 5% RM/A-202C C11, C111 100pF, 500V CM-070-024 R34, R134 1R, 1/4W, 5% RM/A-102C C12, C112 100pF, 500V CM-071-024 R34, R134 1R, 1/4W, 5% RM/A-102C C12, C112 100pF, 500V CM-071-024 R36, R136 1R, 1/4W, 5% RM/A-102C C13, C113 0.047 JIF, 50V CYV-473-024 R37, R137 100, 1/4W, 5% RM/A-102C C14, C114 20, 22F, 500V CM-220-024 R37, R137 100, 1/4W, 5% RM/A-102C C16, C115 680pF, 500V CM-281-024 R39, R139 100, 1/4W, 5% RM/A-101C C15, C115 680pF, 500V CM-470-024 R39, R139 100, 1/4W, 5% RM/A-101C C16, C116 47pF, 500V CM-470-024 R39, R139 100, 1/4W, 5% RM/A-101C C16, C116 47pF, 160V CPP-475MC R41, R141 100, 1/4W, 5% RM/A-101C C19, C119 20, 000µF, 100V CPP-475MC R41, R141 100, 1/4W, 5% RM/A-101C C19, C119 20, 000µF, 100V CPP-475MC R43, R143 1R, 1/4W, 5% RM/A-101C C20, C120 20, 000µF, 100V CPR-209F R43, R143 1R, 1/4W, 5% RM/A-101C C20, C120 20, 000µF, 100V CPR-209F R43, R144 47.5, 1/4W, 15% RM/A-102C C21 20, 000µF, 100V CPR-209F R46, R146 100, 1/4W, 5% RM/A-101C C20, C120 20, 00µF, 50V CPR-108C-024 R46, R146 100, 1/4W, 5% RM/A-101C C204 1000µF, 50V CPR-108C-024 R46, R146 100, 1/4W, 5% RM/A-101C C204 1000µF, 50V CPR-108C-024 R48, R148 47.5, 1/4W, 15% RM/A-101C C204 1000µF, 50V CPR-108C-024 R48, R148 47.5, 1/4W, 15% RM/A-101C C204 1000µF, 50V CPR-108C-024 R48, R148 47.5, 1/4W, 15% RM/A-101C C205 0.1µF, 50V CYV-104-024 R49, R149 47.5, 1/4W, 15% RM/A-101C C206 0.1µF, 50V CYV-104-024 R49, R149 47.5, 1/4W, 15% RM/A-101C C206 0.1µF, 50V CYV-104-024 R49, R149 47.5, 1/4W, 15% RM/A-101C C206 0.1µF, 50V CYV-104-024 R49, R149 47.5, 1/4W, 15% RM/A-101C C206 0.1µF, 50V CYV-104-024 R49, R149 47.5, 1/4W, 15% RM/A-101C C206 0.1µF, 50V CYV-104-024 R49, R149 47.5, 1/4W, 15% RM/A-101C C206 0.1µF, 50V CYV-104-024 R49, R149 47.5, 1/4W, 15% RM/A-20C C206 0.1µF, 50V C4PR-108C-024 R49, R149 47.5, 1/4W, 15% RM/A-20C C206 0.1µF, 50V C4PR-10				C7, C107	100μF, 50V	CER-107C-024
R32, R132 100, 114W, 5% RMI4-101C C9, C19 C19, C19 C79-104-024 R33, R133 2k, 1/4W, 5% RMI4-202C C11, C111 100pf, 500V CM-101-024 R34, R134 1k, 1/4W, 5% RMI4-102C C12, C112 C112 C10pf, 500V CM-101-024 R35, R135 1k, 1/4W, 5% RMI4-102C C13, C113 0.047µf, 50V C7V-473-024 R36, R136 1k, 1/4W, 5% RMI4-102C C13, C113 0.047µf, 50V C7V-473-024 R37, R137 100, 1/4W, 5% RMI4-101C C14, C114 22pf, 500V CM-220-024 R38, R138 1k, 1/4W, 5% RMI4-101C C16, C115 C115 C115 C115 R39, R139 100, 1/4W, 5% RMI4-101C C16, C116 47pf, 500V CM-470-024 R40, R140 28k, 1/4W, 5% RMI2802-03 C17, C117 C117 C117 C117 R41, R141 100, 1/4W, 5% RMI4-101C C19, C119 20,000µf, 100V CFP-475MC R42, R142 100, 1/4W, 5% RMI4-101C C19, C119 20,000µf, 100V CFR-209F R43, R143 1k, 1/4W, 5% RMI4-102C C20, C120 0.01µf, 100V CFR-209F R44, R144 47.5, 1/4W, 1/8 RMI4-0475C C201, 202 0.1µf, 50V CD5-104CCDB R46, R146 100, 1/4W, 5% RMI4-101C C204 1000µf, 50V CER-108C-024 R47, R147 100, 1/4W, 5% RMI4-101C C204 1000µf, 50V CER-108C-024 R48, R148 47.5, 1/4W, 1/8 RMI4-0475C C205 0.1µf, 50V CFR-108C-024 R48, R149 47.5, 1/4W, 1/8 RMI4-0475C C206 0.1µf, 50V CFR-108C-024 R48, R149 47.5, 1/4W, 1/8 RMI4-4750C C206 0.1µf, 50V CFR-108C-024 R49, R149 47.5, 1/4W, 1/8 RMI4-4750C C206 0.1µf, 50V CFR-107C-024 R50, R150 475, 1/4W, 1/8 RMI4-4750C C207 100µf, 50V CFR-107C-024 R51, R151 475, 1/4W, 1/8 RMI4-4750C C208 100µf, 50V CFR-107C-024 R52, R155 220, 1/4W, 5% RMI4-221C SW1 DPDT Switch SW-0280 R53, R155 56.2k, 1/4W, 1/8 RMI4-221C SW1 DPDT Switch SW-0280 R506 22k, 1/4W, 1/8 RMI4-221C SW1 DPDT Switch SW-0280 R520 3.92k, 1/4W, 1/8 RMI4-223C S201 Power Switch SW-0280 R506 22k, 1/4W, 1/8 RMI4-223C S201 RMI51088 SS-0114 R200 604k, 1/4W, 1/8 RMI4-223C C2, C100 MMBT508B SS-0					0.1μF, 50V	CYV-104-024
R33, R133				C9, C109	0.1μF, 50V	CYV-104-024
R34, R134				C10, C110	7pF, 500V	CM-070-024
R35, R135				C11, C111	100pF, 500V	CM-101-024
R36, R136				C12, C112	100pF, 500V	CM-101-024
R37, R137 100, 1/4W, 5% RM/4-101C C14, C114 680pf 500V CM-620-024 R38, R138 1k, 1/4W, 5% RM/4-101C C15, C115 680pf 500V CM-470-024 R39, R139 100, 1/4W, 5% RM/4-101C C16, C116 47pf, 500V CM-470-024 R40, R140 28k, 1/4W, 5% RM/2802-03 C17, C117 4.7µf, 160V CPP-475MC CPP-475MC CPP-475MC R41, R141 100, 1/4W, 5% RM/4-101C C19, C119 20,000µf, 100V CFR-209E				C13, C113	0.047μF, 50V	CYV-473-024
R38, R138 R1, 1/4W, 5% RM/4-102C C16, C116 47pF, 500V CM-80F-1024 R39, R139 100, 1/4W, 5% RM/4-101C C17, C117 4.7μF, 160V CPP-475MC R41, R141 100, 1/4W, 5% RM/2802-03 C18, C118 4.7μF, 160V CPP-475MC R41, R141 100, 1/4W, 5% RM/4-101C C19, C119 20,000μF, 100V CER-209E R42, R142 100, 1/4W, 5% RM/4-101C C20, C120 20,000μF, 100V CER-209E R44, R144 47.5, 1/4W, 5% RM/4-102C C21 0.01μF, 100V CD-103/20-024 R44, R144 47.5, 1/4W, 1% RM/4-0475C C21 0.01μF, 50V CD-103/20-024 R44, R144 47.5, 1/4W, 5% RM/4-101C C204 1000μF, 50V CER-108C-024 R46, R146 100, 1/4W, 5% RM/4-101C C204 1000μF, 50V CER-108C-024 R47, R147 100, 1/4W, 5% RM/4-101C C205 0.1μF, 50V CFR-108C-024 R47, R147 100, 1/4W, 5% RM/4-0475C C205 0.1μF, 50V CFR-108C-024 R49, R149 475, 1/4W, 1% RM/4-4750C C206 0.1μF, 50V CVV-104-024 R49, R149 475, 1/4W, 1% RM/4-4750C C206 0.1μF, 50V CFR-107C-024 R50, R150 475, 1/4W, 1% RM/4-4750C C208 100μF, 50V CER-107C-024 R51, R151 475, 1/4W, 1% RM/4-4750C C208 100μF, 50V CER-107C-024 R52, R15 475, 1/4W, 1% RM/4-4750C C209 10μF, 50V CER-107C-024 R52, R15 475, 1/4W, 1% RM/4-4750C C206 100μF, 50V CER-107C-024 R53, R153 56.2k, 1/4W, 1% RM/4-4750C C209 10μF, 50V CER-107C-024 R53, R153 56.2k, 1/4W, 1% RM/4-21C C210 4.7μF, 160V CTR-475A-024 R54, R154 220, 1/4W, 5% RM/4-221C SW1 DPDT Switch SW-0280 R58, R158 0.1/4W, 1% RM/4-221C SW2 DPDT Switch SW-0280 R58, R158 0.1/4W, 1% RM/4-223C SW3 DPDT Switch SW-0280 R58, R158 0.1/4W, 1% RM/4-223C SW3 DPDT Switch SW-0280 R58, R158 0.1/4W, 1% RM/4-223C SW3 DPDT Switch SW-0280 SW-0				C14, C114	22pF, 500V	CM-220-024
R39, R139 100, 1/4W, 5% RM/4-101C C16, C116 4 7pF, 160V CM-4/0-024 R40, R140 28k, 1/4W, 5% RM/2802-03 C18, C118 4.7μF, 160V CPP-475MC R41, R141 100, 1/4W, 5% RM/4-101C C19, C119 20,000μF, 100V CER-209E R42, R142 100, 1/4W, 5% RM/4-101C C20, C120 20,000μF, 100V CER-209E R43, R143 1k, 1/4W, 5% RM/4-102C C21 0.01μF, 1000V CD-103/20-024 R44, R144 47.5, 1/4W, 1% RM/4-0475C C21 0.01μF, 1000V CD-103/20-024 R45, R145 1k, 1/4W, 5% RM/4-102C C201, 202 0.1μF, 50V CDS-104CCDB R46, R146 100, 1/4W, 5% RM/4-101C C203 1000μF, 50V CER-108C-024 R47, R147 100, 1/4W, 5% RM/4-101C C204 1000μF, 50V CER-108C-024 R48, R148 47.5, 1/4W, 1% RM/4-0475C C205 0.1μF, 50V CVY-104-024 R49, R149 475, 1/4W, 1% RM/4-4750C C208 100μF, 50V CER-107C-024 <td></td> <td></td> <td></td> <td></td> <td></td> <td>CM-681-024</td>						CM-681-024
R40, R140 28k, 1/4W, 5% RM/2802-03 C17, C117 4.7μF, 160V CPP-475MC R41, R141 100, 1/4W, 5% RM/4-101C C19, C119 20,000μF, 100V CER-209E R42, R142 100, 1/4W, 5% RM/4-101C C19, C119 20,000μF, 100V CER-209E R43, R143 1k, 1/4W, 5% RM/4-102C C20, C120 20,000μF, 100V CER-209E R44, R144 47-5, 1/4W, 1% RM/4-102C C21 0.01μF, 1000V CD-103/20-024 R45, R145 1k, 1/4W, 5% RM/4-101C C203 1000μF, 50V CER-108C-024 R46, R146 100, 1/4W, 5% RM/4-101C C204 1000μF, 50V CER-108C-024 R47, R147 100, 1/4W, 5% RM/4-101C C205 0.1μF, 50V CYV-104-024 R48, R148 47-5, 1/4W, 1% RM/4-4750C C205 0.1μF, 50V CYV-104-024 R50, R150 475, 1/4W, 1% RM/4-4750C C208 100μF, 50V CER-107C-024 R51, R151 475, 1/4W, 1% RM/4-4750C C209 10μF, 50V CER-107C-024 <						
R41, R141 100, 1/4W, 5% RM/4-101C C19, C118 4.7μr, 160V CFR-4/5MC R42, R142 100, 1/4W, 5% RM/4-101C C19, C119 20,000μF, 100V CER-209E R43, R143 1k, 1/4W, 5% RM/4-101C C20, C120 20,000μF, 100V CD-103/20-024 R45, R145 1k, 1/4W, 5% RM/4-102C C21 0.01μF, 1000V CD-103/20-024 R45, R145 1k, 1/4W, 5% RM/4-102C C201, 202 0.1μF, 50V CDS-104CCDB R45, R145 1k, 1/4W, 5% RM/4-101C C203 1000μF, 50V CER-108C-024 R47, R147 100, 1/4W, 5% RM/4-101C C204 1000μF, 50V CFR-108C-024 R48, R148 47.5, 1/4W, 1% RM/4-0475C C205 0.1μF, 50V CYV-104-024 R48, R148 47.5, 1/4W, 1% RM/4-4750C C206 0.1μF, 50V CYV-104-024 R48, R148 47.5, 1/4W, 1% RM/4-4750C C206 0.1μF, 50V CFR-107C-024 R51, R151 475, 1/4W, 1% RM/4-4750C C208 100μF, 50V CER-107C-024 R51, R151 475, 1/4W, 1% RM/4-4750C C208 100μF, 50V CFR-107C-024 R52, 152 475, 1/4W, 1% RM/4-4750C C209 10μF, 50V CFR-107C-024 R53, R153 56-2k, 1/4W, 1% RM/4-4750C C209 10μF, 50V CFR-106C-024 R53, R153 56-2k, 1/4W, 1% RM/4-21C C210 4.7μF, 160V CTR-475A-024 R55, R155 220, 1/4W, 5% RM/4-221C C211 4.7μF, 160V CTR-475A-024 R55, R155 220, 1/4W, 5% RM/4-221C SW1 DPDT Switch SW-0280 R58, R158 0, 1/4W, 1% RM/4-221C SW2 DPDT Switch SW-0280 R58, R158 0, 1/4W, 1% RM/4-3921C SW3 DPDT Switch SW-0280 R58, R158 0, 1/4W, 1% RM/4-3921C SW3 DPDT Switch SW-0280 R505 22k, 1/4W, 1% RM/4-3921C SW3 DPDT Switch SW-0280 R505 22k, 1/4W, 1% RM/4-23C T5-201 Inrush Limiter SSH-618 R207 22k, 1/4W, 1% RM/4-23C T5-201 Inrush Limiter SSH-618 R207 22k, 1/4W, 1% RM/4-23C T5-201 Inrush Limiter SSH-618 R207 22k, 1/4W, 1% RM/4-23C Q3, Q103 MMBT5088L SS-0114 R210 470k, 1/4W, 5% RM/4-23C Q4, Q104 MMBT5088L SS-0114 R210 470k, 1/4W, 5% RM/4-23C Q5, Q105 MMBT5088L SS-0114 R210 470k, 1/4W, 5% RM/4-23C Q5, Q105 MMBT5088L SS-0114 R211 1k, 1/4W, 5% RM/4-102C Q5, Q105 MMBT5088L SS-0114 R211 1k, 1/4W, 5% RM/4-102C Q5, Q105 MMBT5088L SS-0114 R211 1k, 1/4W, 5% RM/4-102C Q5, Q105 MMBT5088L SS-0114					•	
R42, R142 100, 1/4W, 5% RM/4-101C C19, C120 20,000μF, 100V CER-209E R43, R143 1k, 1/4W, 5% RM/4-102C C20, C120 20,000μF, 100V CD-103/20-024 R44, R144 47.5, 1/4W, 1% RM/4-02C C21 0.01μF, 1000V CD-103/20-024 R45, R145 1k, 1/4W, 5% RM/4-101C C203 1000μF, 50V CER-108C-024 R46, R146 100, 1/4W, 5% RM/4-101C C204 1000μF, 50V CER-108C-024 R47, R147 100, 1/4W, 5% RM/4-101C C205 0.1μF, 50V CFR-108C-024 R48, R148 47.5, 1/4W, 1% RM/4-0475C C206 0.1μF, 50V CYV-104-024 R49, R149 475, 1/4W, 1% RM/4-4750C C207 100μF, 50V CER-107C-024 R50, R150 475, 1/4W, 1% RM/4-4750C C208 100μF, 50V CER-107C-024 R51, R151 475, 1/4W, 1% RM/4-4750C C208 100μF, 50V CER-107C-024 R52, 152 475, 1/4W, 1% RM/4-2750C C208 100μF, 50V CER-107C-024 <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>						
R43, R143 1k, 1/4W, 5% RM/4-102C C20, C120 20,000 μг, 100V CER-209F R44, R144 47.5, 1/4W, 1% RM/4-0475C C21 0.01 μF, 50V CD-103/20-024 R45, R145 1k, 1/4W, 5% RM/4-101C C203 1000μF, 50V CER-108C-024 R46, R146 100, 1/4W, 5% RM/4-101C C204 1000μF, 50V CER-108C-024 R47, R147 100, 1/4W, 5% RM/4-101C C205 0.1 μF, 50V CER-108C-024 R48, R148 47.5, 1/4W, 1% RM/4-0475C C205 0.1 μF, 50V CYV-104-024 R49, R149 475, 1/4W, 1% RM/4-4750C C206 0.1 μF, 50V CYV-104-024 R50, R150 475, 1/4W, 1% RM/4-4750C C208 100μF, 50V CER-107C-024 R51, R151 475, 1/4W, 1% RM/4-4750C C208 100μF, 50V CER-107C-024 R52, 152 475, 1/4W, 1% RM/4-4750C C209 10μF, 50V CER-106C-024 R53, R153 56.2k, 1/4W, 1% RM/4-221C C21 4.7 μF, 160V CTR-475A-024						
R44, R144 47.5, 1/4W, 1% RM/4-0475C C21, 202 0.1μF, 50V CD5-10320-024 R45, R145 1k, 1/4W, 5% RM/4-102C C201, 202 0.1μF, 50V CD5-104CCDB R46, R146 100, 1/4W, 5% RM/4-101C C203 1000μF, 50V CER-108C-024 R47, R147 100, 1/4W, 5% RM/4-101C C204 1000μF, 50V CFR-108C-024 R48, R148 47.5, 1/4W, 1% RM/4-0475C C205 0.1μF, 50V CYV-104-024 R49, R149 475, 1/4W, 1% RM/4-4750C C206 0.1μF, 50V CYV-104-024 R50, R150 475, 1/4W, 1% RM/4-4750C C208 100μF, 50V CER-107C-024 R51, R151 475, 1/4W, 1% RM/4-4750C C208 100μF, 50V CER-106C-024 R52, 152 475, 1/4W, 1% RM/4-4750C C208 100μF, 50V CER-106C-024 R53, R153 56.2k, 1/4W, 1% RM/4-250C C210 4.7μF, 160V CTR-475A-024 R54, R154 220, 1/4W, 5% RM/4-221C C215 0.01μF, 160V CTR-475A-024	•					
R45, R145 1k, 1/4W, 5% RM/4-102C C203 1000μF, 50V CER-108C-024 R46, R146 100, 1/4W, 5% RM/4-101C C204 1000μF, 50V CER-108C-024 R47, R147 100, 1/4W, 5% RM/4-101C C204 1000μF, 50V CER-108C-024 R48, R148 47.5, 1/4W, 1% RM/4-0475C C205 0.1μF, 50V CYV-104-024 R49, R149 475, 1/4W, 1% RM/4-4750C C206 0.1μF, 50V CER-107C-024 R50, R150 475, 1/4W, 1% RM/4-4750C C208 100μF, 50V CER-107C-024 R51, R151 475, 1/4W, 1% RM/4-4750C C208 100μF, 50V CER-107C-024 R52, 152 475, 1/4W, 1% RM/4-4750C C209 10μF, 50V CER-106C-024 R53, R153 56.2k, 1/4W, 1% RM/4-4750C C209 10μF, 50V CER-106C-024 R54, R154 220, 1/4W, 5% RM/4-221C C211 4.7μF, 160V CTR-475A-024 R54, R154 220, 1/4W, 5% RM/4-221C C21 D1μF, 50V CTR-475A-024						
R46, R146 100, 1/4W, 5% RM/4-101C C203 1000μF, 50V CER-108C-024 R47, R147 100, 1/4W, 5% RM/4-101C C204 1000μF, 50V CER-108C-024 R48, R148 47.5, 1/4W, 1% RM/4-0475C C205 0.1μF, 50V CYV-104-024 R49, R149 475, 1/4W, 1% RM/4-4750C C206 0.1μF, 50V CER-107C-024 R50, R150 475, 1/4W, 1% RM/4-4750C C208 100μF, 50V CER-107C-024 R51, R151 475, 1/4W, 1% RM/4-4750C C209 10μF, 50V CER-106C-024 R52, 152 475, 1/4W, 1% RM/4-4750C C209 10μF, 50V CER-106C-024 R53, R153 56.2k, 1/4W, 1% RM/4-4750C C210 4.7μF, 160V CTR-475A-024 R54, R154 220, 1/4W, 5% RM/4-221C C211 4.7μF, 160V CTR-475A-024 R55, R155 220, 1/4W, 5% RM/4-221C SW1 DPDT Switch SW-0280 R57, R157 220, 1/4W, 5% RM/4-221C SW2 DPDT Switch SW-0280 <td< td=""><td></td><td></td><td></td><td></td><td></td><td></td></td<>						
R49, R148						
R49, R149 47.5, 1/4W, 1% RM/4-4750C C206 0.1μF, 50V CYV-104-024 R50, R150 475, 1/4W, 1% RM/4-4750C C207 100μF, 50V CER-107C-024 R51, R151 475, 1/4W, 1% RM/4-4750C C208 100μF, 50V CER-107C-024 R51, R151 475, 1/4W, 1% RM/4-4750C C209 10μF, 50V CER-107C-024 R52, 152 475, 1/4W, 1% RM/4-4750C C209 10μF, 50V CER-106C-024 R52, 152 475, 1/4W, 1% RM/4-4750C C209 10μF, 50V CER-106C-024 R53, R153 56.2k, 1/4W, 1% RM/4-4750C C210 4.7μF, 160V CTR-475A-024 R54, R154 220, 1/4W, 5% RM/4-221C C211 4.7μF, 160V CTR-475A-024 R55, R155 220, 1/4W, 5% RM/4-221C SW1 DPDT Switch SW-0280 R57, R157 220, 1/4W, 5% RM/4-221C SW2 DPDT Switch SW-0280 R58, R158 0, 1/4W, 1% RM/4-3921C SW3 DPDT Switch SW-0280 R203 3,92k, 1/4W, 1% RM/4-3921C S201 Power Switch SWH-152	R47, R147	100, 1/4W, 5%	RM/4-101C			
R49, R149 475, 1/4W, 1% RM/4-4/50C C207 100μF, 50V CER-107C-024 R50, R150 475, 1/4W, 1% RM/4-4750C C208 100μF, 50V CER-107C-024 R51, R151 475, 1/4W, 1% RM/4-4750C C209 10μF, 50V CER-107C-024 R52, 152 475, 1/4W, 1% RM/4-4750C C210 4.7μF, 160V CTR-475A-024 R53, R153 56.2k, 1/4W, 1% RMP/4-5622-03 C211 4.7μF, 160V CTR-475A-024 R54, R154 220, 1/4W, 5% RM/4-221C C215 0.01μF, 1600V CTR-475A-024 R55, R155 220, 1/4W, 5% RM/4-221C SW1 DPDT Switch SW-0280 R57, R157 220, 1/4W, 5% RM/4-221C SW2 DPDT Switch SW-0280 R58, R158 0, 1/4W, 1% RM/4-221C SW3 DPDT Switch SW-0280 R202 3.92k, 1/4W, 1% RM/4-3921C S201 Power Switch SWH-152B R203 3.92k, 1/4W, 1% RM/4-3921C S201 Power Switch SWH-152B R205 22k, 1/4W, 1% RM/4-223C TS-201 Inrush Limiter SSH-618<	R48, R148	47.5, 1/4W, 1%	RM/4-0475C		•	
R51, R151 475, 1/4W, 1% RM/4-4750C C208 100μF, 50V CER-107C-024 R51, R151 475, 1/4W, 1% RM/4-4750C C209 10μF, 50V CER-106C-024 R52, 152 475, 1/4W, 1% RM/4-4750C C210 4.7μF, 160V CTR-475A-024 R52, R153 56.2k, 1/4W, 1% RM/4-2622-03 C211 4.7μF, 160V CTR-475A-024 R54, R154 220, 1/4W, 5% RM/4-221C C215 0.01μF, 1600V CD-103A-024 R55, R155 220, 1/4W, 5% RM/4-221C SW1 DPDT Switch SW-0280 R57, R157 220, 1/4W, 5% RM/4-221C SW2 DPDT Switch SW-0280 R58, R158 0, 1/4W, 1% RM/4-221C SW2 DPDT Switch SW-0280 R58, R158 0, 1/4W, 1% RM/4-221C SW3 DPDT Switch SW-0280 R202 3.92k, 1/4W, 1% RM/4-3921C SW3 DPDT Switch SW-0280 R203 3.92k, 1/4W, 1% RM/4-3921C S201 Power Switch SW-0280 R205 22k, 1/4W, 1% RM/4-23C TS-201 Inrush Limiter SSH-618 R207 22k, 1/4W, 1% RM/4-223C TS-201 Inrush Limiter SSH-618 R207 22k, 1/4W, 1% RM/4-223C TS-201 MMBT5088L SS-0114 R210 470k, 1/4W, 1% RM/4-23C Q4, Q104 MMBT5088L SS-0114 R210 470k, 1/4W, 4% RM/4-102C Q5, Q105 MMBT5088L SS-0114 R211 1k, 1/4W, 5% RM/4-102C Q6, Q106 MMBT5088L SS-0114 R212 1k, 1/4W, 5% RM/4-102C Q6, Q106 MMBT5088L SS-0114	R49, R149	475, 1/4W, 1%	RM/4-4750C			
R51, R151 475, 1/4W, 1% RM/4-4750C C209 10μF, 50V CER-106C-024 R52, 152 475, 1/4W, 1% RM/4-4750C C210 4.7μF, 160V CTR-475A-024 R53, R153 56.2k, 1/4W, 1% RM/4-5622-03 C211 4.7μF, 160V CTR-475A-024 R54, R154 220, 1/4W, 5% RM/4-221C C215 0.01μF, 1600V CD-103A-024 R55, R155 220, 1/4W, 5% RM/4-221C SW1 DPDT Switch SW-0280 R57, R157 220, 1/4W, 5% RM/4-221C SW2 DPDT Switch SW-0280 R57, R157 220, 1/4W, 5% RM/4-221C SW2 DPDT Switch SW-0280 R58, R158 0, 1/4W, 1% RM/4-3921C SW3 DPDT Switch SW-0280 R202 3.92k, 1/4W, 1% RM/4-3921C S201 Power Switch SW-0280 R205 22k, 1/4W, 1% RM/4-3921C S201 Power Switch SW-152B R205 22k, 1/4W, 1% RM/4-223C TS-201 Inrush Limiter SSH-618 R207 22k, 1/4W, 1% RM/4-223C TS-201 Inrush Limiter SSH-618 R207 22k, 1/4W, 1% RM/4-223C Q2, Q102 MMBT5088L SS-0114 R209 604k, 1/4W, 1% RM/4-223C Q3, Q103 MMBT5088L SS-0114 R210 470k, 1/4W, 4% RM/4-474C Q4, Q104 MMBT5088L SS-0114 R211 1k, 1/4W, 5% RM/4-102C Q6, Q106 MMBT508L SS-0115 R212 1k, 1/4W, 5% RM/4-102C Q6, Q106 MMBT5088L SS-0114	R50, R150	475, 1/4W, 1%	RM/4-4750C		•	
R52, 152	R51, R151	475, 1/4W, 1%	RM/4-4750C			
R54, R154 220, 1/4W, 5% RM/4-221C C215 0.01μF, 160V CTR-475A-024 R55, R155 220, 1/4W, 5% RM/4-221C S20, 1/4W, 5% RM/4-221C SW1 DPDT Switch SW-0280 R57, R157 220, 1/4W, 5% RM/4-221C SW2 DPDT Switch SW-0280 R58, R158 0, 1/4W, 1% RM/4-000C SW3 DPDT Switch SW-0280 R202 3.92k, 1/4W, 1% RM/4-3921C S201 Power Switch SW-0280 R205 22k, 1/4W, 1% RM/4-3921C S201 Power Switch SW-152B R205 22k, 1/4W, 1% RM/4-23C R206 22k, 1/4W, 1% RM/4-23C R207 22k, 1/4W, 1% RM/4-23C R208 22k, 1/4W, 1% RM/4-23C R208 22k, 1/4W, 1% RM/4-23C R208 22k, 1/4W, 1% RM/4-23C R209 604k, 1/4W, 1% RM/4-23C Q2, Q102 MMBT5088L SS-0114 R209 604k, 1/4W, 1% RM/4-6043C Q4, Q104 MMBT5088L SS-0114 R210 470k, 1/4W, 4% RM/4-474C Q5, Q105 MMBT5087L SS-0115 R212 1k, 1/4W, 5% RM/4-102C Q6, Q106 MMBT5088L SS-0114 R212 1k, 1/4W, 5% RM/4-102C Q6, Q106 MMBT5088L SS-0114	R52, 152	475, 1/4W, 1%	RM/4-4750C		•	
R54, R154	R53, R153		RMP/4-5622-03			
R55, R155	R54, R154	220, 1/4W, 5%	RM/4-221C		•	
R57, R157		220, 1/4W, 5%	RM/4-221C	0213	0.01μ1, 1000 ν	CD-103A-024
R57, R157			RM/4-221C	SW1	DPDT Switch	SW-0280
R58, R158					DPDT Switch	SW-0280
R202 3.92k, 1/4W, 1% RM/4-3921C S201 Power Switch SWH-152B R205 22k, 1/4W, 1% RM/4-223C TS-201 Inrush Limiter SSH-618 R207 22k, 1/4W, 1% RM/4-223C TS-201 Inrush Limiter SSH-618 R207 22k, 1/4W, 1% RM/4-223C Q2, Q102 MMBT5088L SS-0114 R208 22k, 1/4W, 1% RM/4-223C Q3, Q103 MMBT5088L SS-0114 R209 604k, 1/4W, 1% RM/4-6043C Q4, Q104 MMBT508BL SS-0114 R210 470k, 1/4W, 4% RM/4-474C Q5, Q105 MMBT508BL SS-0114 R211 1k, 1/4W, 5% RM/4-102C Q6, Q106 MMBT508BL SS-0115 R212 1k 1/4W, 5% RM/4-102C Q6, Q106 MMBT508BL SS-0114						
R205						
R206 22k, 1/4W, 1% RM/4-223C TS-201 Inrush Limiter SSH-618 R207 22k, 1/4W, 1% RM/4-223C Q2, Q102 MMBT5088L SS-0114 R208 22k, 1/4W, 1% RM/4-223C Q3, Q103 MMBT5088L SS-0114 R209 604k, 1/4W, 1% RM/4-6043C Q4, Q104 MMBT5088L SS-0114 R210 470k, 1/4W, 4% RM/4-474C Q5, Q105 MMBT5087L SS-0115 R211 1k, 1/4W, 5% RM/4-102C Q6, Q106 MMBT5088L SS-0114 R212 1k, 1/4W, 5% RM/4-102C Q6, Q106 MMBT5088L SS-0114				S201	Power Switch	SWH-152B
R207 22k, 1/4W, 1% RM/4-223C R208 22k, 1/4W, 1% RM/4-223C R209 604k, 1/4W, 1% RM/4-6043C R210 470k, 1/4W, 4% RM/4-474C R211 1k, 1/4W, 5% RM/4-102C R212 1k 1/4W, 5% RM/4-102C R213 1k 1/4W, 5% RM/4-102C R214 R215 R217 R217 R217 R217 R217 R217 R217 R217				TC 201	Inrush Limitor	014 니22
R208				13-201	IIII USII LIIIIILEI	J3∏-U1Ŏ
R208				Q2, Q102	MMBT5088L	SS-0114
R209 604K, 1/4W, 1% RM/4-6043C Q4, Q104 MMBT5088L SS-0114 R210 470K, 1/4W, 4% RM/4-474C Q5, Q105 MMBT5087L SS-0115 R211 1k, 1/4W, 5% RM/4-102C Q6, Q106 MMBT5088L SS-0114 R212 1k 1/4W, 5% RM/4-102C Q6, Q106 MMBT5088L SS-0114				•		
R210 470K, 1/4W, 4% RM/4-474C Q5, Q105 MMBT5087L SS-0115 R211 1k, 1/4W, 5% RM/4-102C Q6, Q106 MMBT5088L SS-0114						
R211 1K, 1/4W, 5% RM/4-102C Q6, Q106 MMBT5088L SS-0114						
Q7, Q107 MMBT5087L SS-0115						SS-0114
	114 14	IN, 1/TVV, J/0	101011 T- 1020	Q7, Q107	MMBT5087L	SS-0115

DESIGNATOR Q8, Q108 Q10, Q110 Q11, Q111 Q12, Q112 Q13, Q113 Q14, Q114 Q15, Q115 Q16, Q116 Q17, Q117 Q45, Q145 Q46 Q146 Q47, Q147 Q48, Q148 Q49, Q149	VALUE MMBT5087L MMBT5088L MMBT5087L MMBT5088L MMBT5087L MPS-A56 MPS-A56 MPS-A66 MPS-A06 2SK1058 2SK1058 2SK1058 2SK1058	PART # SS-0115 SS-0114 SS-0115 SS-0114 SS-0115 SS-101A SS-101A SS-102A SS-102A SSH-741T SSH-741T SSH-741T SSH-741T SSH-741T
Q50, Q150	2SJ162	SSH-740T
Q51, Q151	2SJ162	SSH-740T
Q52, Q152	2SJ162	SSH-740T
Q201	MMBT5087L	SS-0115
Q202	MMBT5088L	SS-0114
Q203	MMBT5088L	SS-0114
F1, F101	AGC 10A Fuse	FS-010
F2, F102	AGC 10A Fuse	FS-010
F201	15A Slo/Blo	FS-015SB
F203, F204	2.5A Fast Mini	FS-0390

DESIGNATOR	VALUE	PART #
BR201	Bridge Rectifier	SS-222
BR301	Bridge Rectifier	SSH-609
BR-302	Bridge Rectifier	SSH-609
	IEC Connector	CC-0918
	IEC Line Cord	FA-0209
	Dual Binding Post	CC-0867
	MOSFET Insulator	HWH-442

9303 Difference	IEC Line Cord	FAH-146
C19, C119 C20, C120	15000μf, 75V 15000μf, 75V	CER-159ES CER-159ES
F201	10A, Slo/Blo	FS-010SM
Q47, Q147 Q50, Q150	Not Used 2SK/1058 2SJ/162	

9303 / 9505 Functional Block Diagram



TECHNICAL REFERENCE

THEORY AND OPERATION OF trans • nova

The (<u>TRANS</u>conductance <u>NO</u>dal <u>Voltage Amplifier</u>) principle is based on our 1984 U.S. Patent 4,467,288. This patent describes the advantages of audio power amplifiers in which a MOSFET output stage is connected in a grounded source configuration. In this connection the output stage has its full voltage gain of typically 20dB (ten times), instead of the usual 1dB loss of voltage follower designs.

It is an inevitable result of electrical physics that this output with gain inherently increases the power gain (for the same bandwidth) of the output stage by typically ten times over the conventional follower connection, using exactly the same MOSFET devices.

The output stage is thus now ten times less wasteful of its incoming drive power. The driver stage can now be of a low voltage (±24 volts) nature and be designed along the same principles always used in high quality preamplifiers: Class A operation, high linearity, and wide bandwidth. A topology utilizing an output stage with gain yields a much simpler, shorter total signal path than that of the usual high voltage driver designs. The number of serial stages is reduced from five or more, to only three.

But all of the above does not make an amplifier trans • nova. The output stage is further refined into a trans-impedance stage (current-to-voltage converter), to achieve extremely short loop (fast) negative feedback. The output stage is driven cooperatively by a transconductance stage (voltage-to-current converter).

The 9303and 9505are the most sophisticated amplifiers we have yet developed utilizing the basic trans • *nova* principle. And, although the measured specifications are very good, the numbers do not describe the realistic sound of the amplifiers.

CIRCUIT IMPLEMENTATION

Earlier models of amplifiers we have offered using the trans • nova topology have earned the reputation for clean, natural sounding reproduction. A conservative, purist design approach was used to avoid compromising the desirable characteristics of the trans • nova circuits. Circuit innovation was not prevented by this conservatism; as is evident in the discoveries which resulted in development of the DIABLO circuitry to be discussed shortly, and the novel balanced input system.

Many "balanced" amplifiers are merely conventional unbalanced designs with a Balanced-to-Unbalanced converter (usually IC op-amp based) preceding the power amplifier. The 9303 and 9505, however, are true differential input power amplifiers. Each (+) and (–) input port has been buffered to allow direct signal access to the differential amplifier, without conversion to unbalanced form. Deactivating the Balanced Mode is accomplished via a rear panel switch that grounds the (–) inputs, effectively converting the amplifier to unbalanced operation.

The input stage is a JFET differential amplifier. This circuit configuration results in excellent front end headroom and extremely low intermodulation effects. The ultra low noise characteristic of the JFETs virtually eliminates noise "mixing" (intermodulation) with the music signal, reducing discordant product frequencies known as "noise grain" or "noise fuzz." A servo integrator has been employed to establish minimal DC offset. This circuit monitors the DC offset at the output of the amplifier, and injects an equal but opposite DC voltage into the (+) port of the differential input, thereby cancelling the offset. This method eliminates the need for a sonically degrading electrolytic capacitor in the audio path, and provides superior subsonic frequency response.

The final output stage utilizes lateral MOSFETs; four pairs are used for each channel in the 9505 and three pairs in the 9303. These devices, unlike conventional bipolar transistors do not exhibit "thermal runaway." Thermal runaway is a phenomenon whereby a transistor heats up as it draws more current, which causes it to get hotter, and conduct more current, and so on until the device self destructs. Since the MOSFETs are inherently self protecting, no sonically degrading, complex circuitry is required to monitor and protect the devices. The lateral MOSFETs also have a linear input to output transfer function. Their connection in circuits and their operating characteristics are very similar to vacuum tubes, which is perhaps responsible for their widely recognized sonic trait of being "musical" and non-fatiguing.

Operation of the transconductance stage is a major factor in the reproduction quality of the amplifier. The number of MOSFETs used at the output stage of the 9303 and 9505 imposes sufficient capacitive load on the transconductance stage that if a conventional Class A stage were used (having intrinsically a 2:1 limit on peak-to-quiescent current) it would begin to show "stress" at the higher audio frequencies. The newly perfected DIABLO driver system (**D**ynamically Invariant **A-B** Linear **O**peration; patent application in progress) satisfies the current headroom requirement by smoothly and continuously varying the current transfer ratios of the two transconductance paths, under the control of the signal current itself. This implementation allows the current transfer ratio of one path to be smoothly and continuously reduced to zero while the other is smoothly and continuously increased by a factor of two. What is remarkably new here is that when this normally-limiting 2:1 value is reached there is now about 14dB of additional, perfectly linear current headroom left to drive the MOSFETs! The result is a dramatic decrease in high-frequency distortion combined with higher ultrasonic stability – the "Holy Grail" of amplifier design.

The power supply utilizes a UI style transformer with a separate primary for each channel. The transformer has a separate secondary for each channel high voltage power supply, each feeding a conventional split full wave bridge rectifier. High voltage power supply capacitance is $20,000\mu\text{F}$ per rail for each channel for the 9505 and 5,000 for the 9303. The third transformer secondary feeds a regulated supply for the input stage and driver circuitry. Low voltage power supply capacitance is $1,000\mu\text{F}$ per rail, with additional decoupling for each channel.

CALIBRATION

Common Mode Rejection:

The input common mode null is adjusted by the trim pot R1 (R101 for the left channel). The CMRR should be greater than 75dB below rated output. If the CMRR requires adjustment, feed the amplifier input with a common mode signal and adjust R1. **Disconnect the power to the amplifier before removing the cover.** Use a sinewave generator set to 1 volt output at 1kHz. Connect the generator signal output to the tip and ring of a 1/4" plug and ground to the sleeve. Plug this into the amplifier input. Connect an AC voltmeter to the amplifier output binding posts. Adjust R1 to give the lowest voltage output from the amplifier. For a temporary adjustment when a signal generator and voltmeter are not available, use an FM tuner and tune it to an unused station as your signal source, and connect the output to the amplifier as described above. Connect the amplifier output to a small full range speaker and adjust R1 for the lowest output from the speaker.

Bias:

The bias control establishes the quiescent Class AB output current of the amplifier. The bias should not need readjustment from the factory setting; however, if the amplifier is repaired and output devices have been changed, or if the two channels of the amplifier do not run at the same temperature, calibrating the bias is necessary. **Disconnect the power to the amplifier before removing the cover**. To adjust the bias, disconnect the input and speakers and remove the B+ fuse for that channel. Connect an amp meter across the now vacant fuse clips and adjust R45 (R145 for the left channel) to get a current reading of 300mA for the 9303, 400mA for the 9505.

SERVICE POLICY AND LIMITED WARRANTY

If you encounter any difficulty or have any question concerning your 9303 and 9505 Amplifier, please call our Technical Support Department weekdays, 8:00 a.m. to 3:30 p.m., Mountain Standard Time, at 800-795-2385.

Should you have any doubts as to whether the amplifier is malfunctioning and requires service, please call us before sending it in for repair. All units being returned (regardless of warranty status) must receive a Return Authorization (RA) number. In addition, we can offer troubleshooting assistance that may simplify or even eliminate the need for factory service.

The Hafler 9303 and 9505 Amplifiers are warranted to the original owner (non-transferrable) for seven years from the date of purchase, including parts, labor, and return shipping costs within the Continental United States, Alaska, and Hawaii. This warranty applies only to products sold in the United States Of America.

For warranties outside the U.S.A., please contact your local agent.

It is the owner's responsibility to pay shipping (preferably United Parcel Service, UPS) to the factory: collect shipments will not be accepted. Units under warranty should be accompanied by a copy of the dated Bill Of Sale. Use the original carton and all packing material, with the RA number clearly marked on the outside of the package. Be sure to include a return address, the RA number, a daytime telephone number, and a brief description of the difficulty, including whether it occurs continuously or intermittently.

This warranty gives you specific legal rights. You may also have other rights which may vary from state to state.



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